

WHAT IS CLAIMED IS:

1. A synchronous rectification type DC/DC converter comprising:

5 a main transistor;

a synchronization transistor connected in series to the main transistor;

a control circuit, connected to the main transistor and the synchronization transistor, for alternately activating the main transistor and the synchronization transistor for a predetermined activation time; and

a capacitor, connected to the control circuit and charged when the synchronization transistor is activated, for supplying the control circuit with charge voltage used to activate the main transistor;

the control circuit including a charging time setting circuit for setting the predetermined activation time of the main transistor and the synchronization transistor.

20 2. The DC/DC converter according to claim 1, wherein the charging time setting circuit generates a pulse signal having a pulse width that is adjusted to ensure that the capacitor is charged for a sufficient charging time, the control circuit using the pulse signal to control the main transistor and the synchronization transistor.

30 3. The DC/DC converter according to claim 2, wherein the charging time setting circuit adjusts the pulse width of the pulse signal so that the activation time of the synchronization transistor increases when the capacitor is not charged to a predetermined voltage.

4. The DC/DC converter according to claim 1, wherein

the DC/DC converter generates output voltage in accordance with voltage generated by the activation and inactivation of the main transistor and the synchronization transistor, the control circuit including:

5 an error amplification circuit for comparing the output voltage of the DC/DC converter with a reference voltage to generate an error signal;

 a comparison circuit, connected to the error amplification circuit, for comparing the error signal with a
10 triangular wave signal to generate a comparison pulse signal having a pulse width that is in accordance with the comparison;

 a first output circuit, connected to the main transistor, for generating a first drive signal, provided to
15 the main transistor, with a synthesized signal; and

 a second output circuit, connected to the synchronization transistor, for generating a second drive signal, provided to the synchronization transistor, with the synchronized signal;

20 the charging time setting circuit including:

 a pulse generation circuit for receiving a reference pulse signal and generating a first pulse signal having one pulse for every predetermined number of pulses of the received reference pulse signal;

25 a pulse width setting circuit, connected to the pulse generation circuit, for generating a second pulse signal having a pulse width that is in accordance with the charging time of the capacitor by using the first pulse signal generated by the pulse generation circuit; and

30 a signal synthesizing circuit, connected to the comparison circuit and the pulse width setting circuit, for generating the synthesized signal by synthesizing the comparison pulse signal of the comparison circuit with the

second pulse signal of the pulse width setting circuit.

5. The DC/DC converter according to claim 4, wherein the control circuit includes an oscillation circuit,
5 connected to the comparison circuit and the pulse generation circuit, for generating the triangular wave signal and the reference pulse signal.

6. The DC/DC converter according to claim 4, wherein
10 the pulse generation circuit stops generating the first pulse signal in response to a control signal.

7. The DC/DC converter according to claim 6, wherein the charging time setting circuit includes a charge time
15 determination circuit for determining whether the charging of the capacitor is sufficient and generates the control signal in accordance with the determination.

8. The DC/DC converter according to claim 7, wherein
20 the charge determination circuit compares the voltage of the capacitor with the reference voltage to determine whether the charging of the capacitor is sufficient.

9. The DC/DC converter according to claim 7, wherein
25 the charge determination circuit determines whether the charging of the capacitor is sufficient from the comparison pulse signal of the comparison circuit.

10. The DC/DC converter according to claim 7, wherein
30 the charge determination circuit compares the output voltage of the DC/DC converter with input voltage of the DC/DC converter to determine whether charging of the capacitor is sufficient.

11. The DC/DC converter according to claim 1, wherein the DC/DC converter generates output voltage in accordance with voltage generated by the activation and inactivation of the main transistor and the synchronization transistor, the control circuit including:

an error amplification circuit for comparing the output voltage of the DC/DC converter with a reference voltage to generate an error signal;

a comparison circuit, connected to the error amplification circuit, for comparing the error signal with a triangular wave signal to generate a comparison pulse signal having a pulse width that is in accordance with the comparison;

a first output circuit, connected to the main transistor, for generating a first drive signal, provided to the main transistor, with a synthesized signal; and

a second output circuit, connected to the synchronization transistor, to generate a second drive signal, provided to the synchronization transistor, with the synchronized signal;

the charging time setting circuit including:

a pulse generation circuit for generating a first pulse signal having one pulse that appears whenever a predetermined time elapses;

a pulse width setting circuit, connected to the pulse generation circuit, for generating a second pulse signal having a pulse width that is in accordance with the time the capacitor is charged by using the first pulse signal generated by the pulse generation circuit; and

a signal synthesizing circuit, connected to the comparison circuit and the pulse width setting circuit, for generating the synthesized signal by synthesizing the

comparison pulse signal of the comparison circuit with the second pulse signal of the pulse width setting circuit.

12. A synchronous rectification type DC/DC converter
5 comprising:

a main transistor;

a synchronization transistor connected in series to the main transistor;

a control circuit, connected to the main transistor and
10 the synchronization transistor, for alternately activating the main transistor and the synchronization transistor for a predetermined activation time;

a first capacitor, connected to the control circuit and charged when the synchronization transistor is activated,
15 for supplying the control circuit with charge voltage used to activate the main transistor; and

a second capacitor connected in series to the first capacitor;

wherein the DC/DC converter generates output voltage in
20 accordance with voltage generated by the activation and inactivation of the main transistor and the synchronization transistor, the control circuit including:

an error amplification circuit for comparing the output voltage of the DC/DC converter with a reference voltage to
25 generate an error signal;

a comparison circuit, connected to the error amplification circuit, for comparing the error signal with a triangular wave signal to generate a comparison pulse signal having a pulse width that is in accordance with the
30 comparison;

a pause period setting circuit, connected to the comparison circuit, for generating a first control signal and a second control signal in accordance with the

comparison pulse signal of the comparison circuit so that the main transistor and the synchronization transistor are both inactivated during a predetermined period;

5 a first output circuit, connected to the pause period setting circuit and the main transistor, for generating a first drive signal, provided to the main transistor, with the first control signal;

10 a second output circuit, connected to the pause period setting circuit and the synchronization transistor, for generating a second drive signal, provided to the synchronization transistor, with the second control signal;

15 a signal synthesizing circuit, connected to the pause period setting circuit, for synthesizing the first control signal with a reference pulse signal to generate a synthesized signal; and

a third output circuit, connected to the signal synthesizing circuit, for pumping the second capacitor in accordance with the synthesized signal of the signal synthesizing circuit.

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13. A synchronous rectification type DC/DC converter comprising:

a main transistor;

25 a synchronization transistor connected in series to the main transistor;

a first output circuit, connected to the main transistor, for generating a first drive signal to drive the main transistor in accordance with the synthesized signal, the first output circuit having a power supply terminal;

30 a second output circuit, connected to the synchronization transistor, for generating a second drive signal to drive the synchronization transistor in accordance with the synthesized signal;

a capacitor connected to the power supply terminal of the first output circuit and to a node between the main transistor and the synchronization transistor;

an error amplification circuit for comparing the output
5 voltage of the DC/DC converter with a reference voltage to generate an error signal;

a comparison circuit, connected to the error
amplification circuit, for comparing the error signal with a
triangular wave signal to generate a comparison pulse signal
10 having a pulse width that is in accordance with the
comparison;

a pulse generation circuit for generating a one shot
pulse signal at a predetermined time interval;

a pulse width setting circuit, connected to the pulse
15 generation circuit, for generating a setting pulse signal
having a pulse width that is in accordance with the time the
capacitor is charged by using the one shot pulse signal
generated by the pulse generation circuit; and

a signal synthesizing circuit, connected to the
20 comparison circuit and the pulse width setting circuit, for
generating the synthesized signal by synthesizing the
comparison pulse signal of the comparison circuit with the
setting pulse signal of the pulse width setting circuit.

25 14. A semiconductor device incorporating a DC/DC
converter, the DC/DC converter comprising:

a main transistor;

a synchronization transistor connected in series to the
main transistor;

30 a control circuit, connected to the main transistor and
the synchronization transistor, for alternately activating
the main transistor and the synchronization transistor for a
predetermined activation time; and

a capacitor, connected to the control circuit and charged when the synchronization transistor is activated, for supplying the control circuit with charge voltage used to activate the main transistor;

5 the control circuit including a charging time setting circuit for setting the predetermined activation time of the main transistor and the synchronization transistor.

10 15. The semiconductor device according to claim 14, wherein the charging time setting circuit generates a pulse signal having a pulse width that is adjusted to ensure that the capacitor is charged for a sufficient charging time, the control circuit using the pulse signal to control the main transistor and the synchronization transistor.

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16. The semiconductor device according to claim 15, wherein the charging time setting circuit adjusts the pulse width of the pulse signal so that the activation time of the synchronization transistor increases when the capacitor is
20 not charged to a predetermined voltage.

17. A semiconductor device incorporating a DC/DC converter, the DC/DC converter comprising:

a main transistor;

25 a synchronization transistor connected in series to the main transistor;

a control circuit, connected to the main transistor and the synchronization transistor, for alternately activating the main transistor and the synchronization transistor for a
30 predetermined activation time;

a first capacitor, connected to the control circuit and charged when the synchronization transistor is activated, for supplying the control circuit with charge voltage used

to activate the main transistor; and

a second capacitor connected in series to the first capacitor;

wherein the DC/DC converter generates output voltage in
5 accordance with voltage generated by the activation and
inactivation of the main transistor and the synchronization
transistor, the control circuit including:

an error amplification circuit for comparing the output
voltage of the DC/DC converter with a reference voltage to
10 generate an error signal;

a comparison circuit, connected to the error
amplification circuit, for comparing the error signal with a
triangular wave signal to generate a comparison pulse signal
having a pulse width that is in accordance with the
15 comparison;

a pause period setting circuit, connected to the
comparison circuit, for generating a first control signal
and a second control signal in accordance with the
comparison pulse signal of the comparison circuit so that
20 the main transistor and the synchronization transistor are
both inactivated during a predetermined period;

a first output circuit, connected to the pause period
setting circuit and the main transistor, for generating a
first drive signal, provided to the main transistor, with
25 the first control signal;

a second output circuit, connected to the pause period
setting circuit and the synchronization transistor, for
generating a second drive signal, provided to the
synchronization transistor, with the second control signal;

30 a signal synthesizing circuit, connected to the pause
period setting circuit, for generating a synthesized signal
by synthesizing the first control signal with a reference
pulse signal; and

a third output circuit, connected to the signal synthesizing circuit, for pumping the second capacitor in accordance with the synthesized signal of the signal synthesizing circuit.

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18. An electronic device incorporating a DC/DC converter, the DC/DC converter comprising:

a main transistor;

10 a synchronization transistor connected in series to the main transistor;

a control circuit, connected to the main transistor and the synchronization transistor, for alternately activating the main transistor and the synchronization transistor for a predetermined activation time; and

15 a capacitor, connected to the control circuit and charged when the synchronization transistor is activated, for supplying the control circuit with charge voltage used to activate the main transistor;

20 the control circuit including a charging time setting circuit for setting the predetermined activation time of the main transistor and the synchronization transistor.

19. A battery pack for functioning as a power supply of a device, the battery pack comprising:

25 a DC/DC converter for generating charge voltage;

a battery connected to the DC/DC converter and charged by the charge voltage supplied from the DC/DC converter;

the DC/DC converter including:

a main transistor;

30 a synchronization transistor connected in series to the main transistor;

a control circuit, connected to the main transistor and the synchronization transistor, for alternately activating

the main transistor and the synchronization transistor for a predetermined activation time; and

a capacitor, connected to the control circuit and charged when the synchronization transistor is activated,
5 for supplying the control circuit with charge voltage used to activate the main transistor;

the control circuit including a charging time setting circuit for setting the predetermined activation time of the main transistor and the synchronization transistor.

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